

Early Neolithic agriculture (2700–2000 BC) and Kushan period developments (AD 100–300): macrobotanical evidence from Kanispur in Kashmir, India

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Abstract Here we report the results of an archaeobotanical study carried out on Ceramic Neolithic (2700–2000 BC) and Kushan period (AD 100–300) deposits at Kanispur, Kashmir, northern India. Botanical evidence from the Ceramic Neolithic phase reflects a nascent agriculture based on cold-tolerant crops (barley, wheats, lentil, field pea and grass pea) related to farming patterns of adjacent cultures and possibly evidence for the earliest cultivation in the valley. The Kushan period is characterized by a double-cropping pattern, suggesting a change in agricultural practices associated with a population recovery following a post-Neolithic decline. Finds of *Juglans regia*, and *Prunus* cf. *amygdalus* shells in ceramic Neolithic levels, and *Vitis* cf. *vinifera*, *Emblica officinalis* and *Ziziphus* cf. *nummularia* in addition to *J. regia*, and *P.* cf. *amygdalus* during Kushan times suggest that horticulture and foraging played an important role in the diet of the occupants. The present dataset provides new absolute dates for the subsistence economy of the Ceramic Neolithic population in the Kashmir Valley. We also present the oldest directly dated wheat and barley in Kashmir.

Keywords Archaeobotany · Kashmir · Macroremains · Ceramic Neolithic · Crop-diffusion

Introduction

Research into the early spread of cereal agriculture throughout the mountains, deserts and oases of Inner Asia is a rapidly emerging field. Work has focused in particular on compact wheats and East Asian millets, for which the first evidence occurs in the late Neolithic and Bronze Age periods (Fuller 2006; Lu et al. 2009; Harris 2010; Frachetti et al. 2010; Betts et al. 2013; Spengler and Willcox 2013; Spengler et al. 2014; Spengler 2015; Fuller et al. 2016; Miller et al. 2016; Stevens et al. 2016). A number of studies have examined the ecological conditions and social organization of societies engaged in cultivation of these crops in order to understand the spread of these domesticates as an archaeologically visible early proxy for other forms of cultural interaction. So far, consideration of the northwestern Himalayan region has been neglected in favour of better studied regions of the Indus (Saraswat and Pokharia 2002, 2003; Fuller 2006, 2011; Pokharia et al. 2011), western China (Flad et al. 2010; Li et al. 2011; Betts et al. 2013; Dodson et al. 2013) and the Central Asian mountains and oases (Frachetti et al. 2010; Spengler et al. 2014, 2016). The precocious agricultural Neolithic of the Valley of Kashmir, in the northernmost fringe of South Asia, with its fertile soils and favourable climate is uniquely situated to bridge a critical gap in these studies. Lying between the Indian subcontinent, Central Asia and the Tibetan Plateau, the Valley of Kashmir, India has long been a focus of cultural interaction. Archaeological evidence from the Neolithic to Medieval periods is indicative of ongoing regional exchange, whilst historical records such as *Nilamata Puran* and *Rajatarangini* allude

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to the protohistoric traditions of tribal Nagas, Pisacas and Yakasas who used to migrate between Tibet and Central Asia in summer and the valley in winters (Stein 1961; Buth et al. 1987).

The Valley of Kashmir is rich in archaeological sites (Pant et al. 1982), but only the sites of Burzahom, Gufkral and Semthan (Fig. 1) have been extensively excavated and studied for plant remains (Kajale 1982; Lone et al. 1993); preliminary flotation sampling has also taken place at Qasim Bagh (Spate et al. 2017). The Kashmir Neolithic has been divided into three phases, Aceramic, Ceramic and Late Neolithic (Megalithic), though these are dated only through a limited number of radiocarbon dates, supplemented by relative chronologies (Bandey 2009; Sharma 2013). The Neolithic sites typically occupy the tops of Upper Karewa terraces (Fig. 1), relict lacustrine sediments deposited when the Kashmir Valley was drowned by a massive mountain lake during the Pleistocene (Sahni 1936).

The earliest Neolithic phase at Gufkral is dated from c. 2500 cal BC with a well-established Aceramic stage (Sharma 2000, 2013). At Burzahom the earliest Neolithic I stage has been dated from c. 2400 cal BC (Bandey 2009). A particular characteristic of these early stages was the use of deep conical pits. The early subsistence economy of the Neolithic population in Kashmir was based on cultivation of winter crops and hunting, with later introductions of domesticated cattle, sheep and goats (Bandey 2009). Rice (*Oryza sativa*), the primary staple cereal in modern Kashmir, appears at Gufkral and Burzahom in Megalithic contexts dated between 1800–1000 cal BC (Kajale 1982; Lone et al. 1993). The rice grains themselves have not been reported with a clear

stratigraphic context, though Sharma (2000) and Lone et al. (1993) both state them to be from strata associated with the transition from the Neolithic to Megalithic periods, at the later end of this date range. The following discussion presents the macrobotanical remains recovered at Kanisapur in the Baramulla District of Kashmir, and contextualizes these in terms of agricultural systems and crop dispersal during the Neolithic and subsequent cultures in the Kashmir valley.

The archaeological site and present vegetation and climate

The archaeological site

The archaeological site Kanisapur (KNP) (Lat. 34°13'35" N; Long. 74°25'30" E), is located 7 km east of Baramulla town, on the Baramulla-Srinagar section of National Highway no. 1A (Mani 2000). The Kanisapur area has been surveyed by past Archaeological Survey of India (ASI) teams, recording Neolithic pottery scatters and early historical material (IAR 1975, 1980, 1984). The present study is the outcome of a single season of excavation at this site, taking place against the difficult backdrop of the Kargil War, undertaken by the Srinagar Circle of ASI under the supervision of B.R. Mani, from late May to August 1999.

Three large open areas designated KNP-I, KNP-II and KNP-III (Fig. 2) were selected for excavation. Trenches in the form of 10×10 m squares, given alphanumeric designations based on their grid positions were laid out for excavation (Fig. 3a, b). These trenches (e.g. A1, A2, Z1, ZC1) were further divided into 5×5 m square quadrants numbered 1 to 4 (Mani 2004). Following this system, an Aceramic Neolithic context may be recorded in KNP-I, square A2, Quadrant 1, as an example. Across the three open areas, a total of five cultural phases—Aceramic Neolithic, Ceramic Neolithic, Kushan, post Kushan and Kashmir Dynastic were identified based on the material culture recovered (Fig. 4a, b). Botanical remains were recovered from Ceramic Neolithic and Kushan Period contexts only and are the focus of the subsequent discussion here.

The Aceramic Neolithic deposit in KNP-I yielded ground stone celts typical of this phase at other sites in Kashmir, though no structural remains were recorded (Mani 2008). Ceramic Neolithic floor layers yielding characteristic pottery and polished stone celts (Fig. 5.1, 5.2) were evident in KNP-I and KNP-II, stratified below a series of Kushan period deposits. Structures of various types, assignable to the Kushan period (Fig. 5.3) were noted at KNP-I, KNP-II and KNP-III. The Kushan remains have been interpreted as remnants of the town of Kanisapur, founded by King Kanishka. The Kushan period in northern India is generally ascribed to the period of AD 100–300 (Mani 2000). From

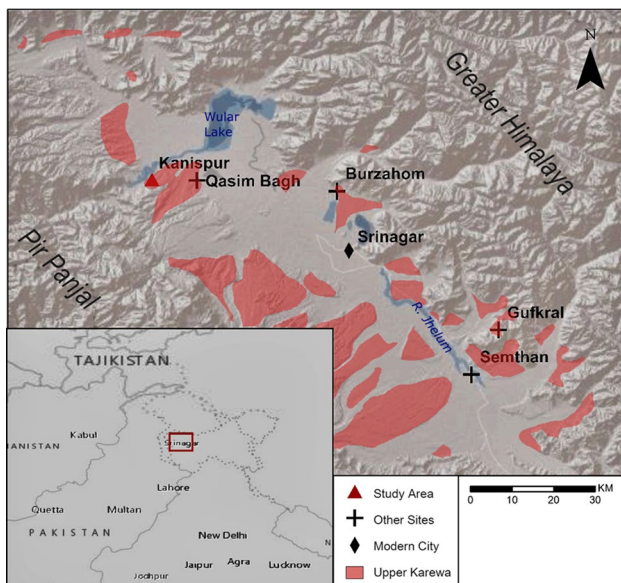


Fig. 1 Kashmir Valley, showing location of Kanisapur and other sites discussed in the text

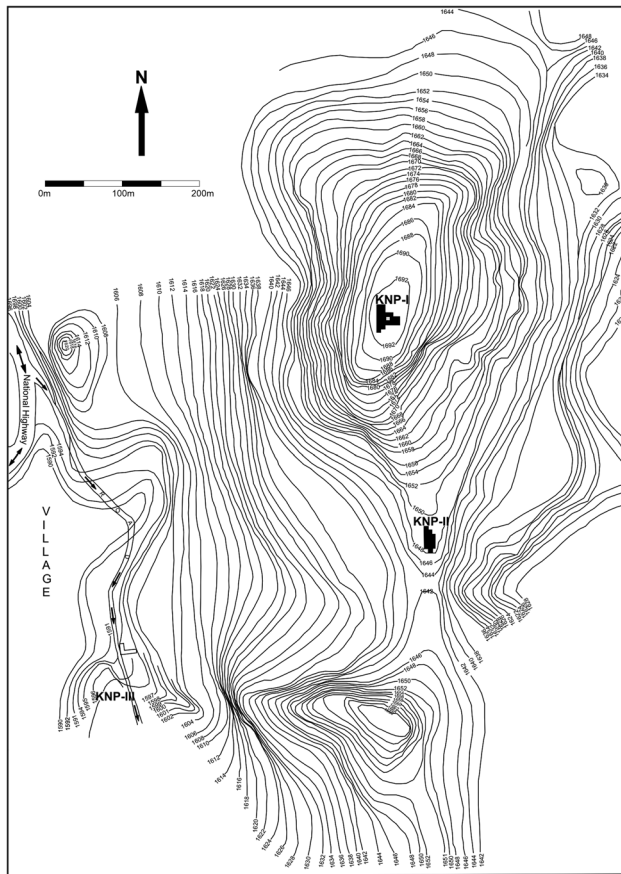


Fig. 2 Contour plan of Kanispur showing KNP-I, KNP-II and KNP-III open areas (modified after Mani 2000)

the occupational layers vases, goblets and decorated terracotta tiles (Fig. 5.4, 5.5) were recovered, in addition to a flower stamped spoked disc, a silver pendant, terracotta human figurines, a typical Kushan lamp and a round stone (Mani 2000).

An 80 cm thick deposit at KNP-I is considered to represent the post-Kushan and pre-Kashmir dynastic period (AD 400–600) dominated by the Hun occupation of the Kashmir Valley (Mani 2000). The top 2.1 m of the deposit at KNP-III represents the final archaeological phase. From this context a copper coin of the medieval Kashmir dynasty was excavated, featuring a king at the altar on the obverse and seated Goddess on reverse, with the legend bearing the name of King Bhimagupta (AD 975–981), suggesting the final occupation of the site in the 10th century AD (Mani 2000).

Vegetation

The vegetation of the Baramulla District (1,700 m a.s.l.) is dominated by temperate conifer forests, which favour dry mountain slopes. At lower elevations *Pinus wallichiana* (blue pine) forests with scanty undergrowth are abundant;



Fig. 3 a General view of Karewa terrace at KNP-I; b excavation at KNP-I

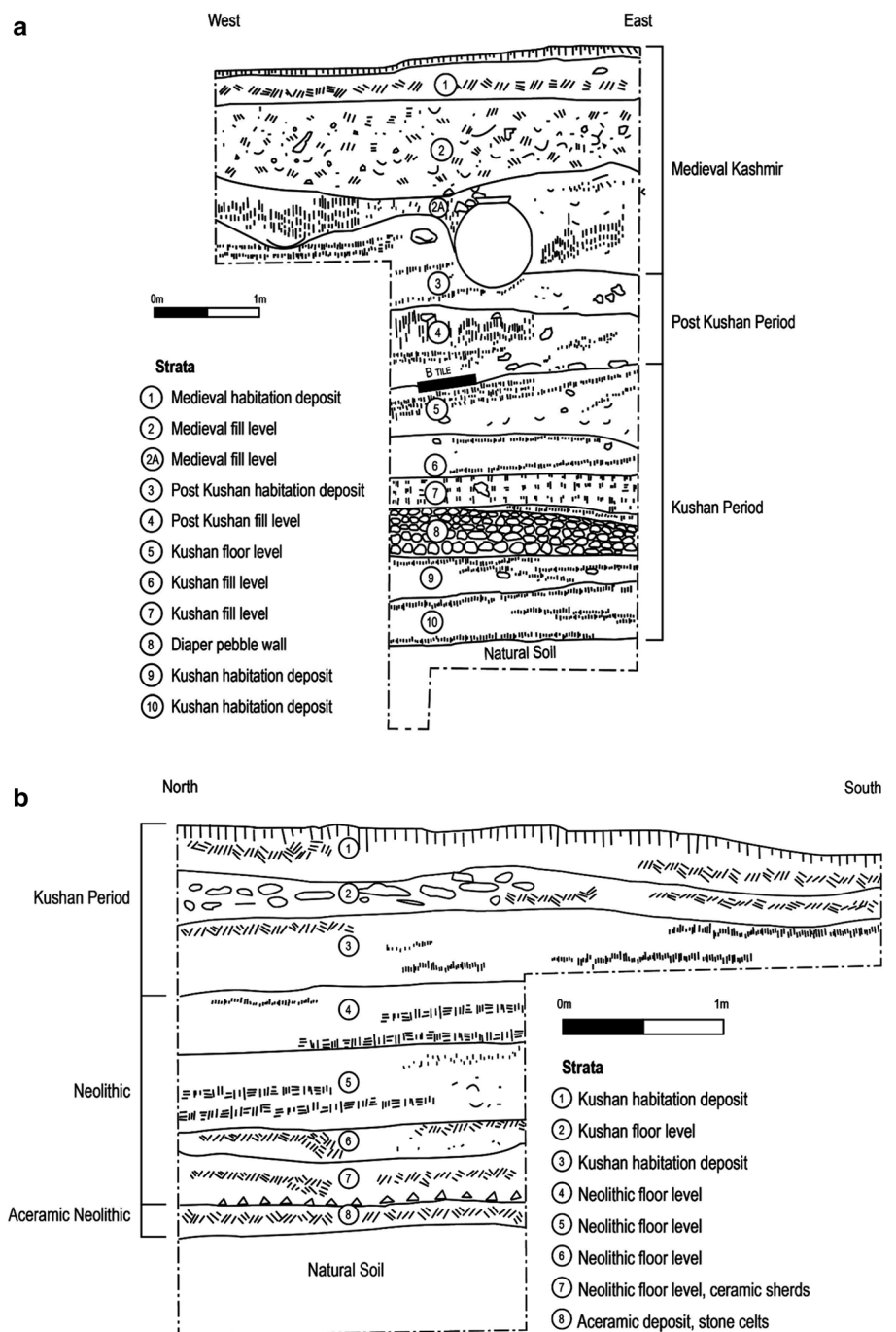
these are gradually replaced by *Cedrus deodara* (deodar) and *Abies pindrow* (fir) on higher open areas. *Pinus gerardiana* (chilgoza pine), *Picea smithiana* (spruce) and *Cupressus* sp. can be found in small restricted pockets in some hilly places. Broad-leaved forests largely composed of *Ulmus wallichiana*, *Aesculus indica*, *Salix alba*, *S. babylonica*, *Acer caesium*, *Quercus incana* and *Fraxinus* occur in shady depressions and sheltered corners of the valleys (Champion and Seth 1968; Singh and Kachroo 1976). Other primary vegetation communities and environments are summarized in Table 1.

The present day agro-ecosystem consists of rice cultivation in irrigated fields, and wheat, barley and pulses in the drylands. The region is known for apple orchards, and other horticultural trees such as *Prunus* and *Juglans* are also cultivated.

Climate

The Kashmir Valley has a local climate that is distinct from that of other areas of South Asia. The orographic effect of the Pir Panjal range generally blocks the impact of the Indian Summer Monsoon, giving rise to a temperate continental climate controlled by Westerly Disturbances

Fig. 4 **a** Section facing West, Trench A2 at KNP-I, representative of Kushan to Dynastic (Medieval) periods; **b** section facing South, Trench A2 at KNP-I, representative of Aceramic to Kushan sequence (modified after Mani 2000)



(Husain 2008). In the higher reaches the temperature remains cold throughout the year, but on the valley floor traditional Kashmiri farmers have a system of six seasons to maximize annual productivity (Husain 2008, p. 56). In a more typical four season continental scheme, winter commences in November and continues to mid-March. The average minimum and maximum temperatures during this period are -1.7 and 10.5 °C, respectively. The lowest winter temperature dips to -2 °C in the extreme cold month

of January. The summer average minimum and maximum temperatures recorded are 14 and 26.3 °C respectively, between mid-May and mid-September. The temperature reaches an average high of 30 °C in June. The Baramulla district receives an average annual precipitation of about $1,200$ mm in the form of rain and snow, with the highest precipitation delivered in March. Another significant feature of the district is the presence of an anabatic wind through the Jhelum Gorge at Baramulla, which provides



Fig. 5 1 Neolithic fineware pottery from Kanispur; 2 Neolithic ground stone tools; 3 Kushan structures exposed at Kanispur; 4 Kushan ceramics; 5 Kushan tiles

Table 1 Vegetation taxa and growing areas, Baramulla district (summarized from Singh and Kachroo 1976)

Environmental niche	Typical species
Forest understory (shrubs)	<i>Zanthoxylum alatum</i> , <i>Crataegus cranulata</i> , <i>Berberis lyceum</i> , <i>Rubus ellipticus</i> , <i>R. niveus</i> , <i>Rosa moschata</i> , <i>Lyonia ovalifolia</i> , <i>Woodfordia fruticosa</i> , <i>Colebrookea oppositifolia</i> , <i>Cinnamomum tamala</i>
Forest understory (herbaceous)	<i>Androsace umbellata</i> , <i>A. rotundifolia</i> , <i>Clematis gouriana</i> , <i>Anagallis arvensis</i> , <i>Rumex dentatus</i> , <i>Sonchus asper</i> , <i>Taraxicum officinale</i> , <i>Oenothera rosea</i> , <i>Viburnum nervosum</i> , <i>V. cotonifolia</i> , <i>Galium asperuloides</i> , <i>Hedera nepalensis</i> , <i>Impatiens balsamina</i> , <i>Ranunculus arvensis</i> , <i>Polygonum khasyanum</i> , <i>Geranium nepalense</i> , <i>Artemisia parviflora</i> , <i>Trifolium repense</i> , <i>Viola serpens</i> , <i>V. biflora</i> , <i>Oxalis cuniculata</i> , <i>Ajuga bracteosa</i> , <i>Cynoglossum glochida</i> , <i>Berginia ligulata</i> , <i>Arisaema jackquemontii</i> , <i>Urtica dioica</i> , <i>Conyza canadensis</i> , <i>Amaranthus tricolor</i> , <i>Bupleurum linearifolium</i>
Moist areas (adjacent to modern villages)	<i>Ficus sp.</i> , <i>F. carica</i> , <i>Toona anaden</i> , <i>Celtis australis</i> , <i>Prunus cerasoides</i> , <i>Pyrus mallus</i> , <i>Grewia oppositifolia</i> , <i>Bauhinia anadensi</i>
Marshy vegetation	<i>Carex schlagintweitiana</i> , <i>Cyperus rotundus</i> , <i>Fimbristylis bisumbellata</i> , <i>Polygonum plebeium</i> , <i>P. hydropiper</i> , <i>Ocimum basilicum</i> , <i>Pimpinella stewartii</i> , <i>Hypericum perforatum</i> , <i>Hydrocotyle sp.</i> , <i>Cetenella asiatica</i>
Aquatics	<i>Typha angustifolia</i> , <i>Nymphoides cristatum</i> , <i>Potamogeton sp.</i> , <i>Lemna</i>

relief during the hot summer months (Kaul 2014, p. 203). The adjacent Gurez, Gulmarg and Bandipore areas experience heavy snowfall during the winter season in comparison to other regions. The surrounding mountains remain

covered with perpetual snow during most of the year. Heavy snowfall occurs in the region during severe cold months from December to February (Dhar and Kachroo 1983; Vishnu-Mittre 1984; Singh et al. 2002).

Table 2 Remains of cereals, pulses, oil seeds and fruits recorded from Kanisapur, Kashmir

Period	Neolithic	Kushan
Cereals		
<i>Hordeum vulgare</i>	50	215
<i>Triticum dicoccum</i>	3	
<i>T. cf. aestivum/durum</i>	10	34
<i>T. cf. sphaerococcum</i>		11
<i>Panicum miliaceum</i>		26
<i>Setaria cf. italica</i>		7
<i>Echinochloa</i> sp.		5
<i>Oryza sativa</i>		59
Pulses		
<i>Lens culinaris</i>	33	31
<i>Pisum arvense</i>	11	46
<i>Lathyrus sativus</i>	16	2
<i>Macrotyloma uniflorum</i>		2
Oil seeds		
<i>Sesamum indicum</i>		1
<i>Linum usitatissimum</i>		2
Fruits		
<i>Juglans regia</i>	5	3
<i>Prunus cf. amygdalus</i>	4	3
<i>Vitis vinifera</i>		1
<i>Emblica officinalis</i>		2
<i>Ziziphus cf. nummularia</i>		6

Table 3 Remains of weeds and wild taxa recorded from Kanisapur, Kashmir

Weeds and wild taxa	Neolithic	Kushan
<i>Papaver</i> sp.	13	
<i>Vicia sativa</i>	7	27
<i>Rumex cf. dentatus</i>	1	6
<i>Medicago</i> sp.	2	
<i>Ipomoea</i> sp.	1	
<i>Scirpus</i> sp.		1
<i>Andropogon</i> sp.		1
<i>Chenopodium album</i>		4
<i>Polygonum</i> sp.		4

Materials and methods

Sampling and identification of the remains

Bulk sediment samples from Neolithic and Kushan dwelling floor levels at KNP-I and KNP-III were processed during the course of excavations by the field team, using on site water flotation. Carbonized botanical materials were then handed over to the Birbal Sahni Institute of

Palaeosciences, Lucknow for analysis. The charred material was segregated under a stereo microscope (Leica Z6APO) and sorted into categories of distinctive morphological types (Tables 2, 3). Length, breadth and width of a representative quantity of each type were measured. Ranges, averages and ratios of these are presented in Table 4. Most remains were found in a good state of preservation, providing insights into the development of the subsistence economy and adaptations to local climate and conditions (Figs. 6, 7).

Radiocarbon dating

Charcoal from stratified layers and floated samples from Aceramic and Ceramic Neolithic phases were used for radiocarbon dating using liquid scintillation counting at BSIP, Lucknow (lab code BS-) (Rajagopalan et al. 1978). Grain samples recovered through flotation of ceramic Neolithic contexts were dated by accelerator mass spectrometry (AMS) at Beta-Analytic, provided by X. Liu, Washington University, St. Louis, USA. The sample preparation method undertaken at Beta-Analytic was done with a standard acid-base-acid (ABA) followed by combustion and graphitization prior to AMS dating (Bronk et al. 2010). Calibration was conducted using OxCal 4.2.4 (Bronk Ramsey and Lee 2013) and the IntCal 13 data set to 2-sigma confidence (Reimer et al. 2013). A summary of these dates is presented in Table 5.

Kushan period

No absolute dates were returned from Kushan Period levels. This period is dated through relative chronology based on comparable cultural materials from Burzahom and Semthan (Mani 2000) and what is known about the Kushan period from historical sources (Chattopadhyay 1967).

Results

Neolithic dates

In open area KNP-I, charcoal dates from square ZC1 give ranges of 3498–2909 (BS-2056) and 2859–2204 (BS-2058) cal BC, the earlier of which comes from the Aceramic/Ceramic horizon between strata 7 and 8 (Table 5). The charcoal date from square A2 (BS-2056) also ranges from 2859 to 2204 cal BC. At 95.4% probability these dates present a strong distribution beginning at 2702 BC; therefore it is argued here for a Ceramic Neolithic phase

Table 4 Measurement and index values of plant remains from Kanispor, Kashmir

Taxa	<i>n</i>	<i>nm</i>	<i>L</i> (mm)	<i>B</i> (mm)	<i>T</i> (mm)	<i>L:B</i>	<i>L:T</i>	<i>B:T</i>
<i>Hordeum vulgare</i>	252	30	5.14 (4.58–5.58)	3.55 (3.14–4.07)	2.01 (1.5–2.4)	1.44	2.55	1.76
<i>H. vulgare</i> var. <i>nudum</i>	13	5	3.38 (3.28–3.48)	2.25 (2.20–2.29)	1.95 (1.9–2.0)	1.50	1.73	1.15
<i>Triticum aestivum/durum</i>	44	15	5.15 (4.75–5.47)	3.25 (2.94–3.86)	1.95 (1.4–2.5)	1.58	2.64	1.66
<i>T. dicoccum</i>	3	2	5.05 (4.86–5.23)	2.66 (2.63–2.69)	1.4 (1.3–1.5)	1.89	3.60	1.9
<i>T. sphaerococcum</i>	11	10	3.64 (3.55–3.74)	3.11 (3.10–3.12)	1.95 (1.8–2.1)	1.17	1.86	1.59
<i>Oryza sativa</i>	59	20	5.46 (5.25–5.69)	2.22 (1.88–2.47)	1.45 (1.2–1.7)	2.45	3.76	1.53
<i>Panicum miliaceum</i>	26	13	1.85 (1.80–1.95)	1.80 (1.74–1.85)	0.83 (0.7–1.0)	1.03	2.23	2.16
<i>Echinochloa</i> sp	5	2	1.23 (1.19–1.26)	1.09 (1.06–1.11)	0.85 (0.8–0.9)	1.13	1.45	1.28
<i>Setaria</i> cf. <i>italica</i>	7	1	2.71	1.87	1.2	1.45	2.25	1.55
<i>Lens culinaris</i>	64	20	3.32 (3.11–3.43)	2.96 (2.85–3.20)	1.4 (1.1–1.7)	1.12	2.37	2.11
<i>Pisum arvense</i>	57	20	3.73 (3.38–4.07), in diameter					
<i>Lathyrus sativus</i>	18	10	3.68 (3.08–4.53)	3.85 (3.06–5.02)	3.33 (3.1–3.5)	0.95	1.11	1.15
<i>Macrotyloma uniflorum</i>	2	1	3.62	2.95	1.5	1.23	2.41	1.96
<i>Sesamum indicum</i>	1	1	2.50	1.30	0.8	1.92	3.13	1.63
<i>Linum usitatissimum</i>	2	1	4.26	1.90	1.0	2.24	4.26	1.9
<i>Vitis vinifera</i>	1	1	6.44	3.96	1.9	1.62	3.38	2.08
<i>Emblia officinalis</i>	2	2	5.18 (4.94–5.42)	2.52 (2.46–2.57)	2.35 (2.2–2.5)	2.05	2.20	1.07
<i>Ziziphus nummularia</i>	6	1	6.29	5.32				
<i>Prunus</i> cf. <i>amygdalus</i>	7	2	11.65 (10.5–13.24)	7.13 (7.03–7.24)				
<i>Juglans regia</i>	8	4	9.67 (8.10–10.93)	5.06 (1.93–6.70)				

n = number of grains/seeds/fruits (Neolithic and Kushan), *nm* = number of grains/seeds/fruits measured

beginning at Kanispor ca. 2700 BC. Directly dated wheat (Beta-422016) and barley (Beta-427232) grains range from 2290 to 2051 cal BC and 2467–2236 cal BC respectively. Both grains come from stratum 6 in KNP-I, trench A2, which is in the middle of the Ceramic Neolithic sequence.

Neolithic botanical remains

All botanical remains from Neolithic contexts were recovered from open area KNP-I, from strata 5, 6 and 7, and were preserved through carbonisation. The total assemblage consists of six varieties of domestic crops, comprised of barley and wheat cereals and legumes including lentil (*Lens culinaris*), field pea (*Pisum arvense*) and grass pea (*Lathyrus sativus*) (Table 2). A single grain from each strata 5–7 was identified as emmer wheat (*Triticum dicoccum*) based on morphological criteria including their elongated and tapering form, humped dorsal ridge and a narrow deep ventral furrow (cf. Jacomet 2006).

From stratum 6, ten wheat grains displayed a wide range of morphologies, though they are generally elongated, round ended and plump. Though no rachis were recovered, the grains appear to be morphologically similar to other free-threshing wheats from South and Central Asia and are tentatively identified as *T. cf. aestivum/durum*. Barley was separated into hulled (*Hordeum vulgare*) and naked (*H. vulgare* var. *nudum*) types, on the basis of longitudinal striation

and transverse rippling. Twisting of the grains indicates they are most likely four-rowed barley.

In addition to the cereals and pulses, endocarps of walnut (*Juglans regia*) and possibly almond (*Prunus* cf. *amygdalus*) were recovered from stratum 5. Palynological and macro fossil remains in Pleistocene *Karewa* sediments show that *Juglans* has been present in Kashmir since at least the last glaciation (Vishnu-Mittre 1965, 1984). A review of palynological evidence has identified the Himalayas as one possible refuge where *J. regia*-type fruits may have been brought under early cultivation (Beer 2007). Various *Prunus*-types may have been translocated throughout Eurasia by the second millennium BC (Stevens et al. 2016). Peach and apricot were likely cultivated in China, with secondary domestications in Central Asia. Stevens et al. (2016) have noted that these could have been spread southwards by agro-pastoralists, though the lack of Chinese millets transported from Central Asia in the Neolithic levels at Kanispor makes this unlikely. Almonds of South or West Asian origin are the most likely *Prunus*-type at Kanispor given the origins of the cereals and pulses in the assemblage.

Weedy taxa from strata 5 and 6 included clover (*Medicago* sp.), opium (?) poppy (*Papaver* sp.), *Ipomoea* sp. and common vetch (*Vicia sativa*). Results are summarised in Table 3. Whilst clover and vetch may be used as forage crops, this seems unlikely due to their low representation.

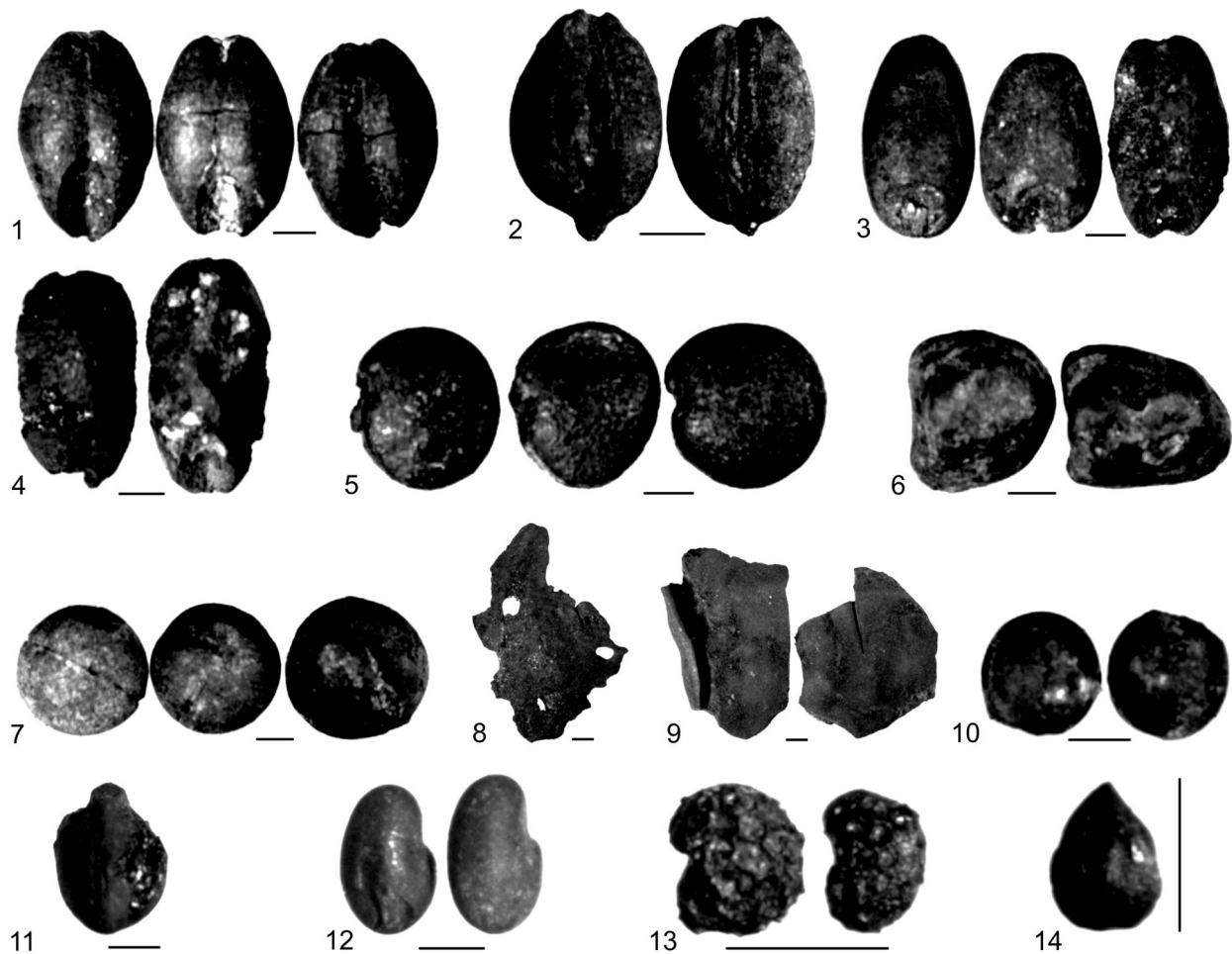


Fig. 6 Botanical macroremains from ceramic Neolithic phase: **1** *Hordeum vulgare*, **2** *Hordeum vulgare* var. *nudum*, **3** *Triticum aestivum/durum*, **4** *Triticum dicoccum*, **5** *Lens culinaris*, **6** *Lathyrus*

sativus, **7** *Pisum arvense*, **8** *Prunus cf. amygdalus*, **9** *Juglans regia*, **10** *Vicia sativa*, **11** *Ipomoea* sp., **12** *Medicago* sp., **13** *Papaver* sp., **14** *Rumex* sp. Scale bars 1 mm

Regarding the use of opium poppy in Central Asia, Sarianidi has controversially identified medicinal or psychoactive use of opium and cannabis at Gonur and Togolok in Bronze Age southern Turkmenistan (Hiebert 1994). The seeds of opium have also been reported from ancient Sanghol, Punjab, India as part of the plant economy of the Baran culture (c. 1900–1400 BC), contemporary with the late Harappan period in the Indus region (Saraswat 1997).

The Neolithic crop assemblage at Kanispor is dominated by hulled and naked barley ($n=50$) and lentil ($n=33$) (Table 2), representing around 70% of the total assemblage, with other crops roughly comprising a remaining 10% each (Fig. 8a).

Kushan botanical remains

Macroremains recovered from Kushan period contexts in areas KNP-I and III give evidence for a broadening of consumption patterns at Kanispor (Table 2; Fig. 8b) Hulled

barley remains the dominant cereal crop ($n=215$), though this period also sees the introduction of broomcorn millet (*Panicum miliaceum*), as well as possible foxtail (*Setaria cf. italica*) and sawa (*Echinochloa* sp.) millets. Whilst the two former millets grow as weedy taxa in Kashmir (Kaul 1986), the grain size may indicate some selection for human consumption—both are cultivated plants in the Himalayas today (Fuller 2006). Rice (*O. sativa*) first becomes evident during the Kushan period at Kanispor. These grains appear to be longer and more slender (Table 4) than rice recovered from other sites in Kashmir (Lone et al. 1993) or culturally related sites in the Swat Valley, Pakistan (Costantini 1987).

During this phase, evidence for lentil ($n=31$) drastically decreases, whilst pea remains at around 10% of the total agricultural assemblage. A small number of *Lathyrus* were recovered, as well as a small number of horse gram (*Macrotyloma uniflorum*), domesticated in the Southern Neolithic of peninsula India (Fuller 2011). Two oil crops were also

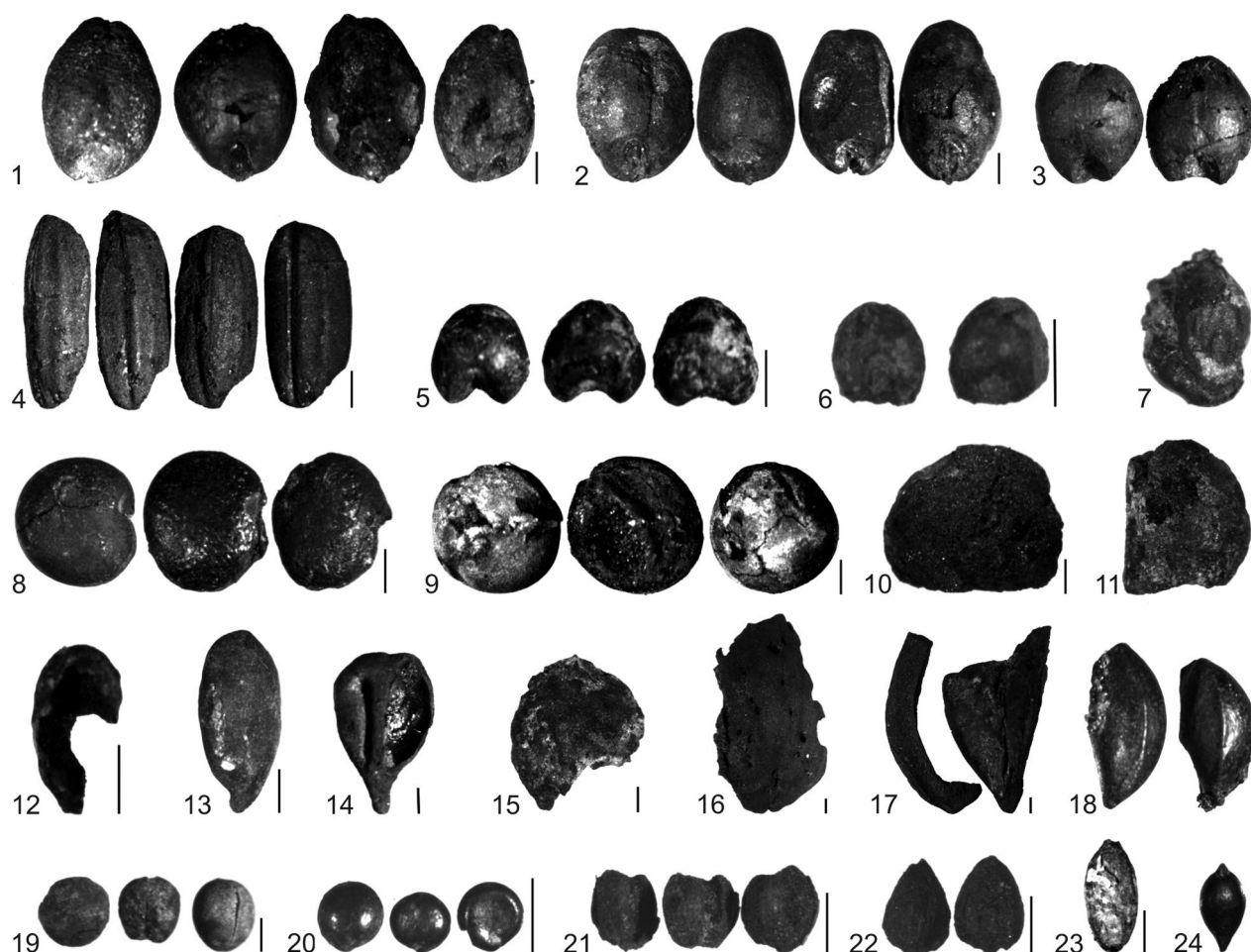


Fig. 7 Botanical macroremains from Kushan period: **1** *Hordeum vulgare*, **2** *Triticum* cf. *aestivum*, **3** *Triticum sphaerococcum*, **4** *Oryza sativa*, **5** *Panicum miliaceum*, **6** *Echinochloa* sp., **7** *Setaria* cf. *italica*, **8** *Lens culinaris*, **9** *Pisum arvense*, **10** *Lathyrus sativus*, **11** *Macrotyloma* sp., **12** *Sesamum indicum*, **13** *Linum usitatissimum*, **14** *Vitis*

vinifera, **15** *Ziziphus* cf. *nummularia*, **16** *Prunus* cf. *amygdalus*, **17** *Juglans regia*, **18** *Emblica officinalis*, **19** *Vicia sativa*, **20** *Chenopodium* cf. *album*, **21** *Polygonum* sp., **22** *Rumex* sp., **23** *Andropogon* sp., **24** *Scirpus* sp. Scale bars 1 mm

Table 5 LSC and AMS radiocarbon dates of charcoal and grains of cereals from Kanispur at 2-sigma (95.4%) probability

Area/trench	Depth (cm)	Layer	Lab code	Material	¹⁴ C date (years BP)	Calibrated age (BC)
KNP-I/ZC1	70	4	BS-2058	Charcoal	3,970 ± 90	2859–2204
KNP-I/ZC1	155	7/8	BS-2055	Charcoal	4,490 ± 100	3498–2909
KNP-I/A2	205	7	BS-2056	Charcoal	3,970 ± 90	2859–2204
KNP-I/A2 ^a	200–130	6	Beta-422,016	Wheat	3,770 ± 30	2290–2051
KNP-I/A2 ^b	200–130	6	Beta-427,232	Barley	3,880 ± 30	2476–2236

AMS radiocarbon dates of charred *Triticum aestivum/durum*^a and *Hordeum vulgare*^b grains were provided by Xinyi Liu, Department of Anthropology, Washington University, St. Louis, USA

introduced, sesame (*Sesamum indicum*) and flax (*Linum usitatissimum*) of South and West Asian origin respectively.

Jujube (*Ziziphus nummularia*) and emblic (Indian gooseberry—*Emblica officinalis*) enter the assemblage, both likely South Asian domesticates. A single grape seed (*Vitis vinifera*) was also recovered, and evidence for

walnut and almond continues (Table 2). Kashmir is within the wild distribution of a number of these plants, though by the Kushan period their presence in archaeological assemblages would most likely indicate horticultural cultivation, rather than management or foraging of wild fruits.

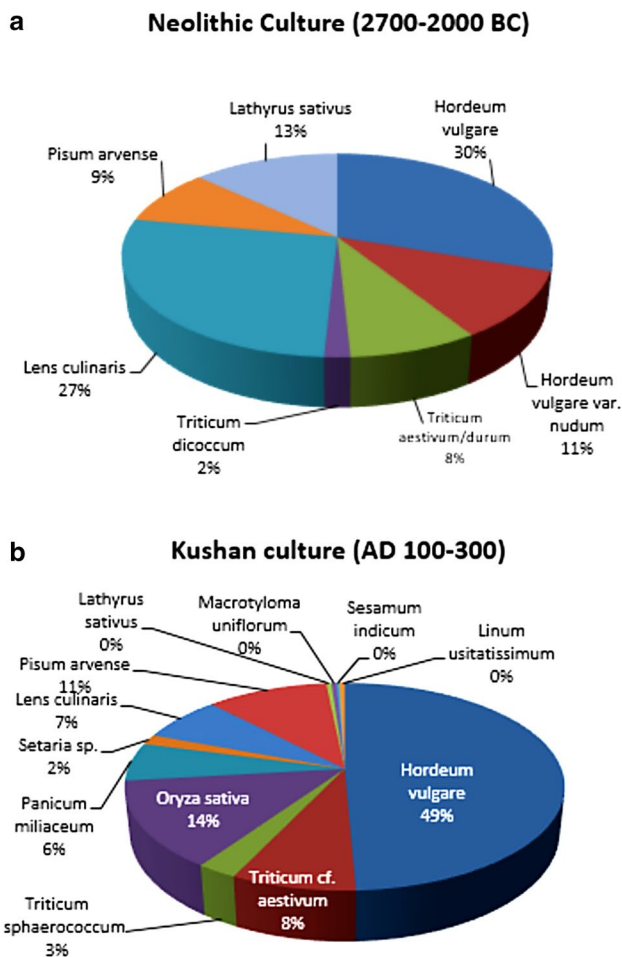


Fig. 8 Relative proportion of charred crop remains; **a** Neolithic culture (2,700–2,000 BC); **b** Kushan culture (AD 100–300) based on number of grains/seeds

A number of weedy taxa were present and are quantified in Table 3.

Discussion

Neolithic chronology

The absolute dates from strata 6 and 7 present the best fit dates for the beginning and middle of the Ceramic Neolithic period (Table 5). The date returned from stratum 4 appears older or out of sequence, which may be ascribed to the effect of old wood, though the younger end of the range for this date is still around 2,200. The presence of burnished black wares in stratum 4 (Mani 2000) may provide a date relative to other sites in Kashmir at around 2000–1500 BC. The nearby site of Qasim Bagh returned direct dates on wheat and millet grains ranging from

around 1800 to 1400 BC, recovered from a context between layers containing burnished wares (Spate et al. 2017).

Based on these absolute and relative dates, there is a strong suggestion that the Aceramic period at Kanispor could be dated to before 3000 BC, several centuries earlier than other Aceramic contexts in the valley (Bandey 2009; Sharma 2013). Despite the lack of a robust set dates from the earliest and final Neolithic strata providing a *terminus post* and *terminus ante quem*, the majority of botanical remains discussed here belong to securely dated deposits and can be assumed to belong to a Ceramic Neolithic period dating from ca. 2700 to ca. 2000 BC.

Early Kashmir Valley agriculture at Kanispor

The crop remains from Neolithic Kanispor all have their origin in Southwest Asia and have generally been considered companions in domestication (Weiss and Zohary 2011). Whilst they were often translocated as a Neolithic “package”, their transmission into Central and South Asia appears to be more complex and may have been adopted in a more uneven fashion (Fuller 2013). Their early co-occurrence in the early agricultural layers at Kanispor may indicate that they were adopted from immediately neighbouring areas, into which they arrived in a more asynchronous fashion. Also notable about the Kanispor Neolithic crop assemblage is the almost equal division between cereal and pulse crops, which may suggest a higher reliance on vegetable rather than animal protein by early settlers at the site.

Baramulla District has long served as the major entry point into the Kashmir Valley from the west, with the Jhelum River gorge being the shortest distance through the Himalayas to the Punjab region, as well as passes into Central Asia (Yattoo 2012, p. 59). Whilst historical records of this route date only to the early centuries AD, there may be good reason to suppose that this route was used during the prehistoric periods and indeed systematic field survey of the Baramulla District has revealed some of the densest concentration of pre-historic and early historic sites in Kashmir (Yattoo 2012). The chronological, archaeological and botanical evidence from Kanispor suggests that the site and the surrounding area may have been the focus of some of the earliest cultivation in the valley.

It is now argued that the transition to agriculture in South Asia has taken multiple pathways, based on localised domestication events, as well the translocation and adoption of crops from adjacent areas by hunter gatherer populations (Fuller and Murphy 2014). In these diverse strategies, varying relationships between sedentism, cultivation and herding emerged, though evidence generally suggests that sedentism preceded agriculture in most places in the subcontinent (Fuller 2011). In Kashmir the relationship between cultivation and settlement is not fully resolved, particularly as large

subterranean conical pits belonging to the Aceramic period and previously believed to be winter dwellings now appear to be structures used for food storage or processing (Conningham and Sutherland 1997; Spate et al. 2017). The dates we report from Kanisapur seem to indicate that some form of long term occupation took place in the Baramulla area before 3000 BC. Though no botanical materials were recovered from these early contexts, the presence of stone celts could be evidence of tilling or working of the land related to some form of early cultivation.

The archaeobotanical evidence from subsequent ceramic Neolithic layers suggests the adoption of West Asian winter crops as a complete package by the populations at Kanisapur. Whilst these crops may have been taken up in an uneven fashion in South and Central Asia, they are firmly established as agricultural packages in the regions neighbouring Kashmir, around 5000 BC at Mehrgarh in Baluchistan (Costantini 2008), and by 4000 at Sheri Khan Tarakai (Thomas and Cartwright 2010) west of the entrance to northern Kashmir. It is from these regions that this domesticate package may have entered the Baramulla area.

The transition to cultivation at Kanisapur may have been driven by ecological conditions within Kashmir. Isotopic, pedological and palynological records indicate that at around 5,000 BP there was a shift from cool, arid conditions in Kashmir towards a warm, wet Holocene optimum (Agrawal 1988; Krishnamurthy et al. 1982). Evidence from the Trans-Himalayan region to the east of Kashmir (Rawat et al. 2015) and the Siwalik foothills to the west (Trivedi and Chauhan 2009) indicate a cold, dry period following 5,000 BP driven by a weakening of the Indian Summer Monsoon. These regionally asynchronous optimal conditions may have influenced cultivators to exploit Kashmir as an ecological niche well suited to cultivation, a pattern that appears to have driven agriculture and settlement in other hilly regions of northern South Asia (Petrie and Thomas 2012).

The origin and choices of cultivars may also explain the composition of the Neolithic botanical assemblage at Kanisapur. Emmer wheat and barley are often seen as poor relatives of free-threshing wheats (Weiss and Zohary 2011), though they are able to withstand water stresses and low quality soils better than other crops. Their presence in the lowest levels at Kanisapur and the introduction of *T. cf. aestivum/durum* only in subsequent phases may suggest that initial cultivation at the site may have been a risk averse strategy by early inhabitants of the site. Comparison (Table 6) of the Kanisapur assemblage with botanical remains from later Neolithic sites in Kashmir suggests a shift away from barley consumption, with assemblages at Burzahom, ca. 2400–1000 BC (Lone et al. 1993) and Gufkral (beginning ca. 2500; Sharma 2013) dominated by wheat. At Qasim Bagh, also in Baramulla district, barley was completely absent from the remains from a single Neolithic

conical pit dated ca. 2000–1400 BC, with the assemblage comprised almost entirely of small wheats, with modest amounts of broomcorn millet (Spate et al. 2017). The temporal gap between the onset of the climate optimum and the shift from barley dominated cultivation at Kanisapur to wheat dominance at Burzahom, Gufkral and Qasim Bagh may be the result of lag time between the climate change and the human response to these conditions.

Pulses make up almost half of the botanical assemblage at Kanisapur, suggesting a reliance of the population of the site on protein from non-animal sources. Faunal remains from the site have not been analysed or reported, but this pattern of consumption is consistent with what is known from the earliest stages at other Neolithic sites in the valley. At Gufkral, the proportion of wild species in the faunal assemblage prior to 2000 BC ranges from over 90 to 43% of the total (Sharma 2013), indicating hunting was a significant part of the subsistence strategy. From this we may assume a similar reliance on hunting at Kanisapur, though the proportion of pulses here far exceeds proportions from the other sites.

The above evidence suggests a protracted transition to agriculture at Kanisapur, possibly beginning as early as 3000 BC. The earliest botanical remains from the site appear to be a more primitive assemblage than from other sites in the valley, though it is unclear whether these crops were transported by in-migrating farmers from adjacent regions, or adopted by local hunter gatherers. There is no evidence yet to date for a hunter-gatherer population in the Kashmir Valley immediately prior to the first Aceramic Neolithic settlements. Based on the comparison of chronology and botanical assemblages, the evidence from Kanisapur points to the Baramulla area as a likely candidate for the earliest entry of agriculture into Kashmir. Though no rachis or other plant fragments were recovered that would indicate processing on site or nearby cultivation, the long chronological span and stratified botanical evidence suggests that cultivation took place in the general environs of Kanisapur.

Kashmir and prehistoric Inner Asian crop exchange

The dispersal of crops from the Indus to Kashmir may be part of a wider regional spread of crops between South, Central and East Asia. Directly dated *Triticum sphaerococcum* at Begash (2170–2150 cal BC) and Tasbas Phase 1 (ca. 2617–2610 cal BC) in southeast Kazakhstan (Frachetti et al. 2010; Doumani et al. 2015) share common morphological traits with wheats from Harappan/Indus sites during earlier phases of the third millennium BC (Weber 1999; Saraswat and Pokharia 2002, 2003; Pokharia et al. 2011). Frachetti (2012) has argued for the dispersal of this crop from southern Central Asia or South Asia through the Pamirs, rather than being carried across the Eurasian steppe. Recovery of

Table 6 Record of economic plants from archaeological sites in Kashmir, India

	Kanisipur, Baramulla		Q. Bagh, Baramulla			Burzahom, Srinagar			Gufkral, Pulwama			Semthan, Anantnag			
	Ceramic Neol.	Early Historic	Neol.	Neol. I	Neol. II	Megalith.	Early Historic	Aceramic Neol. IA	Neol. IB & IC	Megalith.	Historic.	Pre NBP	NBP	Indo-Greek	Early Historic
<i>Hordeum vulgare</i>	+														
<i>H. vulgare</i> var. <i>nudum</i>	+														
<i>Triticum aestivum/durum</i>	+														
<i>T. compactum</i>															
<i>T. dicoccum</i>	+														
<i>T. sphaerococcum</i>															
<i>Oryza sativa</i>															
<i>Eleusine coracana</i>															
<i>Setaria italica</i>															
<i>Panicum miliaceum</i>															
<i>Paspalum scrobiculatum</i>															
<i>Lens culinaris</i>	+														
<i>Pisum arvense</i>	+														
<i>Lathyrus sativus</i>	+														
<i>Cicer arietinum</i>															
<i>Macrotyloma uniflorum</i>															
<i>Vigna mungo</i>															
<i>Vigna aconitifolius</i>															
<i>Sesamum indicum</i>															
<i>Linum usitatissimum</i>															
<i>Prunus cf. amygdalus</i>	+														
<i>Juglans regia</i>	+														
<i>Vitis vinifera</i>															
<i>Emblca officinalis</i>															
<i>Ziziphus nummularia</i>															

+ Indicates presence; Kanisipur (present study); Burzahom (Lone et al. 1993); Gufkral (Sharma 2013; Kajale 1982); Semthan (Buth et al. 1987; Lone et al. 1993); Qasim Bagh (Spate et al. 2017)

early broomcorn millet at Begash as well as from phases at Tasbas have allowed Frachetti to hypothetically model an Inner Asian Mountain Corridor (IAMC), in which the exchange of Chinese domesticates such as millet, and West Asian wheat, barley and peas serve as a proxy for intensified interaction between agro-pastoralist group in the Himalaya, Pamir and Tien Shan from the beginning of the second millennium BC. Spengler (2015) has expanded this notional north–south vector with an east–west arm running through the Himalayas and onto the Tibetan Plateau.

In Kashmir today, wheat and barley are grown as *rabi* crops in Kashmir, sown during the autumn and harvested in spring, whilst in the uplands of the adjacent Ladakh region wheat is a *kharif* crop, sown in May and harvested in August (Qazi 2005). The comparison between the Neolithic agricultural assemblages at Kanisapur and later dated deposits from Burzahom (Lone et al. 1993), Gufkral (Sharma 2013) and a small sample from Qasim Bagh (Spate et al. 2017) indicate a shift away from winter crops to bi-seasonal cereal farming, including the introduction of summer rice and millets from around 1400 BC (Lone et al. 1993). Also notable in the assemblages are a mixture of wheats comparable to both *T. aestivum* and *T. sphaerococcum*. Gene mapping by Kippes et al. (2015) indicates that the introgression of vernalisation traits for spring habit likely took place in the Harappan period, possibly around the Punjab region. The VRN-D4 allele for this trait was found to be present in 31 of 33 modern sphaerococcoid wheat samples from Asia, with two Chinese samples being the exception, though these wheats carried an alternate allele also responsible for spring growth, suggesting that this trait was central to the movement of wheat out of South Asia and ultimately into China via Central Asia.

Based on the shift from winter wheat only at Neolithic Kanisapur to possible mixed farming of winter and spring wheats at Burzahom and Gufkral, we may hypothesize the Kashmir Valley to be an ecological niche that served as a type of “staging post” for the dispersal of *T. sphaerococcum* to the higher latitudes and altitudes of Central Asia and the Tibetan Plateau, where mobile hunting and agro-pastoral groups may have been able to incorporate short season spring crops suitable to local environmental constraints into their patterns of seasonal movement and cultivation (Spengler 2015; D’Alpoim Guedes 2015).

Diversification of consumption during the Kushan Period

The period of the Kushan Empire in Central and South Asia coincided with a globalisation of technology, culture and currency related to the growth of the historic Silk Road. Kushan citizens were described as “thoroughgoing cosmopolitans” (Starr 2013, p. 79), occupying cities connected

with Rome, India and China. Botanical remains from Kushan contexts at Sanghol in the Punjab reflect a wide variety of cereals, pulses, fruits, oil and fibre crops, and spices drawn from across Eurasia and Africa (Pokharia and Saraswat 1999). An examination of botanical remains from Kanisapur may allow us to examine if such globalised tastes were evident in Kashmir at this time.

As with Neolithic sites, the densest recorded number of Kushan remains in Kashmir are in Baramulla district, most likely as this route passed through to the Kushan capitals and major cities at Taxila, Peshawar, Begram and Mathura (Shah 2013). Despite the trans-Eurasian connections of the Kushan Empire, the botanical remains from Kanisapur in the Kushan period continue to be dominated by barley ($n=215$), a proportion that stands in contrast to other Kushan period remains from Semthan, where wheat is most common, followed by roughly equal proportions of barley and rice (Lone et al. 1993).

These differences may be accounted for through variations in either site usage or contexts from which the materials were recovered. Shah (2013) has analysed the architectural remains from the site and compared them to the Kushan temple at Harwan near Srinagar. Analysis of carbonised remains from the Kushan temple at Sanghol (Saraswat and Pokharia 1998) indicated the ritual burning of seven types of food crops, fruits and fragrant woods, a number of which persist in fire sacrifice in South Asia today. Comparable materials are not evident at Kanisapur, suggesting that the botanic remains may have come from domestic or storage contexts.

It is also apparent that there was some form of population collapse or displacement in Kashmir following the final Neolithic period. In the archaeological sequences from Kanisapur (Mani 2000), Gufkral (Sharma 2013) and Burzahom (Bandey 2009), the Late Neolithic phase is followed by a Kushan phase, indicating a temporal disjuncture of up to 1,000 years. Only at Semthan is the Megalithic followed by a Northern Black Polished Ware (NBPW) and Indo-Greek phase prior to the Kushan period (Lone et al. 1993). These periods exhibit a distinctly South Asian material culture and see the introduction of a number of Indian domesticates, though Lone et al. (1993) note that species diversity declines during the Indo-Greek phase and this cultural deposit is the thinnest in the stratigraphic sequence. Agrawal (1988) has argued that this period coincided with the decline of the Holocene optimum and a climate recovery took place only at the start of the Kushan period. In this light we may interpret the broadening of consumption at Kanisapur during the Kushan phase not as the adoption of Silk Road exotica, but a diversification of farming strategies based on locally available crops in order to support a population recovery.

Conclusions

This study has presented new evidence relating to the earliest farming in Kashmir. We have returned the oldest directly dated wheat and barley in the valley, pre-dating the next oldest directly dated wheats at Qasim Bagh by ca. 500 years. The agricultural material and archaeological sequence at the site suggest that the inhabitants of Kanisapur were engaged in a primitive form of winter agriculture, perhaps adopted as a response to shifting conditions in the valley making farming an attractive prospect. Our case study points to the Baramulla District as being a likely entry point for early cultivation into the Kashmir Valley. The shift away from barley and emmer wheat agriculture at other Neolithic sites in the valley suggests that cultivars more suitable to climatic conditions and offering higher nutritional returns may have been rapidly adopted following this initial phase of farming. The optimal climatic conditions in the valley during this period may have supported a higher population, as seen in the proliferation of Neolithic sites following ca. 2000 BC (Bandeey 2009). This growth may have led to Malthusian pressures further driving the shift towards agriculture in the valley.

We have raised questions regarding the expansion of agriculture during the Kushan period. The archaeological and climatic record suggests that there was some form of population recovery during this time, which may be supported through examining the dietary breadth of the Kushan population at Kanisapur suggesting an intensification of agriculture. Until further excavations of Kushan sites in the valley are undertaken these questions cannot be answered definitively.

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